PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
B44C 1/175, 1/17, C03C 17/34, 17/04

A1

(11) International Publication Number: WO 95/15267

(43) International Publication Date: 8 June 1995 (08.06.95)

(21) International Application Number: PCT/GB94/02616

(22) International Filing Date: 30 November 1994 (30.11.94)

(30) Priority Data:
9324616.3 1 December 1993 (01.12.93) GB

(71) Applicant *(for all designated States except US)*: STAINED GLASS SYSTEMS LIMITED [GB/GB]; 5 Hollytree Parade, Sidcup, Kent DA14 6JR (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: EASTON, Leslie, Ralph [GB/GB]; Springfields, Tebbs Way, Ightham, Kent TN15 9BJ (GB). EASTON, Nicholas, Leslie [GB/GB]; Springfields, Tebbs Way, Ightham, Kent TN15 9BJ (GB).

(74) Agent: BRERETON, Paul, Arthur; Reddie & Grose, 16 Theobalds Road, London WC1X 8PL (GB).

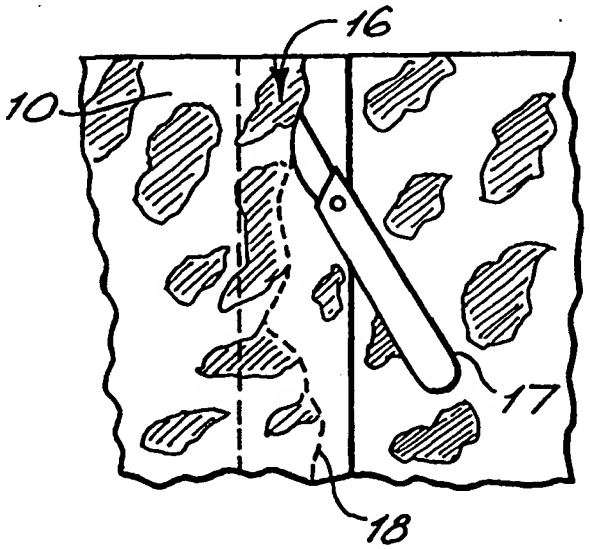
(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).

Published
With international search report.

(54) Title: METHOD FOR PRODUCING DECORATED GLASS PANELS

(57) Abstract

A method of making decorated glass panels, particularly glass panels decorated with designs to simulate stone such as marble, is described. Water-slide transfers (10) are formed by printing designs simulating marble on a backing of gummed paper with an ink of glass frit and coloured metal oxides in a printing medium. Several transfers (10) are soaked in water and then removed from their backing and placed in overlapping relationship on a panel of glass (15). The transfers are cut through in the region of their overlap (16) and the surplus material removed. After drying the panel is passed through a furnace to burn off the printing medium. A coating of ceramic or vitreous enamel material (25) is applied over the design and the panel is then subjected to a second heat treatment cycle in which the glass frits and metal oxide fuse to the glass panel, the coating is baked on to the panel and the glass is toughened by rapidly heating in a furnace and then cooling.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgystan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakhstan
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SI	Slovenia
SK	Slovakia
SN	Senegal
TD	Chad
TG	Togo
TJ	Tajikistan
TT	Trinidad and Tobago
UA	Ukraine
US	United States of America
UZ	Uzbekistan
VN	Viet Nam

Method for producing decorated glass panels

The present invention relates to a method for making decorative glass panels, particularly but not exclusively glass panels that simulate panels of marble, granite or other stone, or other types of grained material such as leather or wood.

It is common practice to use panels of marble or other stone for cladding walls of buildings, either internally or externally. Marble is an expensive material and where it is desired to clad a large building it can be difficult to find enough of a sufficiently uniform colour. Wood and simulation wood panelling and leather or leatherette panelling is also used for facing items such as elevators, and furniture.

The method of the present invention may be used for producing glass panels which look like marble and can be used in applications, such as cladding buildings, where marble or other stone or other materials might have been used.

According to the present invention in a first aspect, there is provided a method for producing a decorated glass panel comprising applying a design to one side of the glass panel as a water-slide transfer, the transfer comprising the design in vitreous enamels, subjecting the glass panel with the applied transfer to a glass-toughening heat treatment cycle, and including the step of applying a layer of material on the same

side of the glass panel as the transfer, whereby the decorative effect is created by the design and the layer of material.

The layer of material may be a layer of pigmented material and may be opaque, semi-opaque, translucent or transparent material. In a practical embodiment the layer is of solid uniform colour. In this context the word 'colour' includes white.

In one preferred form the layer of material is applied over the design. When viewed from the side of the glass opposite the side to which the design and covering layer are applied, the panel will create a decorative effect which depends on the nature of the design applied to the glass and of the covering layer applied. The colour of the covering layer should be chosen to suit the colouring of the design in order to produce the desired decorative effect.

The design of the transfer may represent the fine detail for creating the desired finished decorative effect, such as the graining of marble or other stone or of other material such as leather or wood. The layer of material produces the overall background colour.

The transfer may be produced in the manner described in my patent specification GB-A-2174383A. When producing a design that simulates marble, granite or other stone, a photograph of a piece of natural stone may be prepared and the transfer produced from the

photograph by a known colour printing technique, using a mixture of glass frits and coloured metallic oxides in a printing medium as the printing ink. The choice of colours and types of metallic oxides may have to be adapted to allow for the changes in colour that take place during the firing process.

The layer of material may simply be a layer of paint, or a layer of ceramic or vitreous enamel material or other pigmented material. If paint is used it is preferred that a two-part epoxy resin based paint be used.

The preferred covering is however a layer of ceramic or vitreous enamel material that is applied as a suspension by spraying, painting or roller. Preferably the glass panel is subjected to a glass-toughening heat treatment cycle after the ceramic covering has been applied. The panel may be subjected to a single firing process after both the design and the covering layer have been applied, or to a double firing process: a first heat treatment cycle after the design has been applied and a second heat treatment cycle after the covering has been applied. The second cycle is a glass-toughening cycle. The first cycle may also be a glass-toughening cycle or it may be a cycle at a lower temperature without the rapid cooling required to produce toughening. The temperature of the first cycle may be only sufficient to burn off the printing medium and any cover coat of the transfer without causing fusing of the glass frit.

If the layer of covering material is paint, the

panel may be subjected to the glass-toughening cycle before the layer of paint is applied and no further heat treatment may be necessary. If the paint is of the epoxy resin type it may be preferred to subject the panel to a heating up to say 150°C in order to accelerate the curing process.

The layer of material may also be formed by applying a layer of sheet material over the transfer after the transfer has been subjected to the glass-toughening heat treatment cycle. An adhesive-backed plastics sheet material, for example the material sold under the Trademark FABLON is suitable for this purpose. Such materials are suitable for applications where the glass panel will be used indoors.

For building applications panels of various sizes may be required. It may not be practical to produce transfers in different sizes up to the size of the largest panels required. In order to produce the larger panels several transfers may be used on a single panel of glass. The transfers may bear identical designs.

According to the present invention in a second aspect, transfers are applied to a glass panel with their edges overlapping one another. The transfers are cut through in the region of the overlap along a line which follows the edge of a feature of the design, and the surplus portions of the transfers are removed. In this way, a joint is formed between the adjacent transfers can be formed which is not noticeable in the finished product, and the effect of an obvious repeat

pattern, which would result from using transfers with a pattern where one edge is designed to match up with the opposite edge, is avoided.

An example of how the invention may be performed in practice will now be described with reference to the accompanying diagrammatic drawings, in which:

Figure 1 shows a perspective view of a water slide transfer used in a method according to the present invention;

Figure 2 shows a plan view of a glass panel with transfers being applied according to the method of the present invention;

Figure 3 shows a plan view on an enlarged scale of the panel of Figure 2 with the transfers being cut;

Figures 4 and 5 shows perspective view of the panel of Figure 3 with surplus material being removed from the transfers;

Figure 6 shows a perspective view of a covering being applied to the panel;

Figure 7 shows in schematic form the panel being passed through a furnace during the toughening cycle; and

Figure 8 shows a cross section through the finished panel.

Water-slide transfers 10 bearing a coloured design are prepared as follows. A photograph of a piece of marble is prepared and using conventional printing techniques, the photograph is used to prepare screens for a multi-tone or multi-colour printing of transfers. The design of the transfer reproduces the fine detail of the grained effect of the marble.

Referring to Figure 1, the design 13 is printed on the gummed side 11 of a backing sheet of gummed paper 12 using a screen printing technique. The areas of different tones or colours are built up in separate stages using different screens to build up the complete design. The colours are made up of lead-bearing glass frit mixed with metallic oxides to give colour, and carried in a printing medium. The glass frit is made from a mixture of lead oxide, boric acid and silica which is fused together and then quenched in water and dried. The frit is ground with metallic oxide of the desired colour and then mixed with just sufficient medium to enable it to be printed. The medium has to be burnt off during the heat treatment and the less medium that has to be burnt, the better the results. The printing medium may be cellulose or resinous and serve to bind the colours together.

After the colours have been printed on the gummed paper the coloured areas 13 are covered with an acrylic resin cover coat 14 to protect the transfer during transport and handling.

When it is desired to produce a glass panel bearing

the design, sufficient transfers 10 to cover the panel are soaked in clear water until each transfer is loosened from the gummed-paper backing sheet 12. The transfers 10 are peeled from their backing sheets and laid on one side of the glass panel 15 so that each transfer overlaps the adjacent transfer (see Fig 2). The glass panel 15 may be up to, say, 4.5 metres x 2.5 metres in dimensions. The transfers may conveniently be up to, say, 900 mm x 600 mm so that 25 or more transfers may be required to cover a single panel. The overlap 16 of transfers may be 25 to 100 mm, usually 30 to 40 mm. The maximum size of panel that can be used depends on the size of the furnace in which the heat treatment is performed. The size of the transfers is chosen for convenience of handling and versatility of application.

Once the transfers 10 have been laid in place, and the surplus water removed, the transfers are cut with a craft knife 17 in the region 16 of the overlap along a line 18 that follows the edges major features on the design (see Fig 3). With a marbled pattern the line may follow the boundary between areas of sharply contrasting tone. It may be helpful if the pattern of the design gradually fades towards the edge of the transfer. Once a line has been cut along the edge of each transfer, the surplus piece 19 of the upper layer of the overlapping transfers (Fig 2) is removed. Then the remaining adjacent edge 20 of the transfer is peeled back to reveal the surplus portion 21 of the underlying layer of the adjacent transfer, which is removed (Fig 5) before the peeled back portion is replaced. Once all

overlapping parts have been removed, and the trimmed edges of the transfers abut one another the transfers are allowed to dry for several hours before undergoing a first heat treatment cycle.

In the first heat treatment cycle the glass with the applied transfer are passed slowly through a furnace where the panel is heated to a temperature of approximately 450°C. At this temperature the acrylic resin cover coat 14 and the printing medium are burnt off in the oxidising atmosphere of the furnace, leaving the glass frit and metallic oxide undisturbed on the surface of the glass panel. The temperature does not have to be sufficiently high to fuse the glass frit during this preliminary treatment cycle. The duration of the preliminary heat treatment cycle can be typically 25 minutes to 1 hour, although in some cases the time could be less.

After being heated in the furnace, the panel 15 is allowed to cool. A coating of ceramic or vitreous enamel material 22 of suitable colour, for example white, is then applied to the same side of the glass as the transfer so as to cover the glass frit and metallic oxide layer. Preferably the ceramic or vitreous enamel layer is applied as a paint-like suspension by spraying (Fig 6) and allowed to dry.

When the ceramic or vitreous enamel layer is dry the panel is subjected to a second heat treatment cycle which is a glass toughening cycle (Fig 7). In this second cycle the panel is heated rapidly. The

temperature of the burners in the furnace is typically 700°-750°C and the temperature of the panel reaches 620°-670°C. The glass passes back and forth within the furnace 23 until it reaches the desired temperature. The glass frit and metal oxide fuse to form areas 24 of colour that are fused to the surface of the glass. The ceramic or vitreous enamel layer is baked over surface of the design to form a hard protective layer 25 which enhances the appearance of the design when viewed from the opposite side.

The glass panel remains in the furnace 23 for 3 minutes or less, preferably 2 to 3 minutes. The treatment depends on the thickness of glass used which may typically be from 4 mm to 25 mm. When the panel emerges from the furnace it is blasted with cold air from jets 30 to cause rapid cooling of the surface of the glass and consequent toughening of the glass panel.

The panels produced by the method described above are of toughened glass suitable for use as cladding material for buildings and other application. The colours are resistant to wear and fading. The panels so formed may be lighter than slabs of stone used for the same purpose.

By suitable choices of colours of transparent, semi-transparent and opaque enamels and for the covering of ceramic material various effects may be achieved including an effect of simulated marble.

The glass frits coalesce when they are melted and

the joints between adjacent transfers become imperceptible when the panel has been through all the processing stages. The surface that is outermost in use has a perfect polish because it is the untreated side of the glass.

Where it is desired to produce panels with bevelled or mitred edges or drilled holes for mounting, these operations are performed prior to the toughening cycle.

Although the invention has been described in relation to producing a marble effect panel, the effect other types of stone or other materials such as wood or leather can be produced using the invention by suitable choice of designs and colours. It may also be used with other types of pictorial or patterned designs.

An important application for panels made in accordance with the invention is cladding buildings both internally and externally. It may however be used for panelling in other applications such as for example shower cubicle doors, partitions, room doors, cupboard doors.

Although a covering of ceramic or vitreous material is placed over the design in the embodiment described above, it may be omitted in some applications, for example shower doors, where it may be preferred to use transparent and semi-transparent colours for the transfer so that the finished panel permits some transmission of light.

In the preferred embodiment described the coating of ceramic or vitreous enamel is laid over the design on transfers. Alternatively the coating may be applied to the glass panel first and the decorative pattern in the form of transfers may be applied over the ceramic or vitreous enamel layer afterward.

In the method described above, the preliminary heat treatment cycle involves gentle heating to 450°. It may be preferred to carry out the preliminary heating using the same furnace as for the second heat treatment cycle. For example the glass may be heated to 550 for up to 3 minutes and cooled rapidly afterwards. Such a cycle would be sufficient to fuse the glass frits onto the surface of the glass.

Although the whole of the surface of the glass is shown to be covered with transfers in the embodiment described above, the invention may be applied to only part of the surface.

In the embodiment the transfer is made using a screen printing technique. other techniques could be employed. For example a layer of printing medium or varnish could be applied to the gummed paper in the desired pattern and then dusted with a powder of glass frits and oxide so that the powder adheres to the areas where the printing medium has been applied. The process may be repeated with other colours of powder to build up the design.

As can be seen from the drawings, the design on the

transfer represent the fine detail of the finished article. In the case of simulated marble panelling, the design represents the grained effect of the natural stone. Where it is desired to produce a panel that resembles some other material a transfer is produced that reproduces the fine detail of that other material and a covering layer of material of a colour appropriate for the desired material is used.

Although in the embodiment described above the cover coat is burnt off by pre-firing before the panel is subjected to the glass-toughening cycle, this pre-firing operation may be avoided by using as cover coat that can be removed mechanically, for example by peeling, after the transfer has been applied to the glass. By using a material for the cover coat which is released from the rest of the transfer by subjecting it to infrared radiation or by gentle heating, the cover coat can be removed without pre-firing. The transfer can then be overprinted with a layer of ceramic material to form the background colour. The resulting panel can then be subjected to a single glass-toughening heat treatment cycle which fuses the glass frit of the transfer and the ceramic layer in a single operation.

In another method according to the invention, the cover coat is removed using jets of water. After the transfer has been laid on the glass and dried, the glass frits and printing medium stick to the glass because of the gum on the backing paper. By using suitable materials for the cover coat it can then be removed by directing jets of water onto the panel.

Where it is necseesy to use more than one transfer to cover a panel, the transfers should preferably be overlapped, cut in the region of the overlap and the surplus removed. For marbled effects such as described above, the cut may follow a meandering line, but for other effects such as wood veneer a staraight or uniformly curved line may be appropriate.

Although the process described above uses water-slide transfers, other forms of transfers such as heat-release transfers may be used.

C L A I M S :

1. A method for producing a decorated glass panel comprising applying a design to one side of the glass panel as a transfer, the transfer comprising the design in vitreous enamels, subjecting the glass panel with the applied transfer to a glass-toughening heat treatment cycle, and including the step of applying a layer of material on the same side of the glass panel, the decorative effect of the panel being created by viewing the layer of material through the design.

2. A method according to Claim 1,in which the layer of material is applied over the design.

3. A method according to claim 1 in which the layer of material is applied as a uniform layer prior to the application of the transfer, and in which the transfer is applied over the said layer.

4. A method according to Claims 1, 2 or 3 in which the layer of material is applied prior to the glass-toughening heat treatment cycle.

5. A method according to Claims 1, 2, 3 or 4 in which the layer of material comprises a coating of ceramic or vitreous material.

6. A method according to Claims 1, 2, 3, 4 or 5 in which the covering is applied by painting, spraying or rolling.

7. A method according to Claims 1, 2, 3, 4, 5 or 6, in which the design is formed by transfers which are applied to the glass panel with their edges overlapping one another, and including the step of cutting through the transfers in the region of the overlap along a line which follows the edge of a feature of the design, and removing the surplus portions of the transfers.

8. A method according to any of the preceding claims in which the layer of material is a layer of coloured material.

9. A method according to claim 8 in which the layer of material is of substantially uniform colour.

10. A method for producing a decorated glass panel comprising applying a design to one side of the glass panel as a plurality of water-slide transfers, the transfers comprising the design in vitreous enamels, the transfers being applied to the panel with their edges overlapping one another, and including the step of cutting through the transfers in the region of the overlap along a line , and removing the surplus portions of the transfers.

11. A method according to claim 10 in which the cut line follows the edge of a feature of the design.

12. A method according to any of the preceding claims, in which the panel simulate a natural grained material.

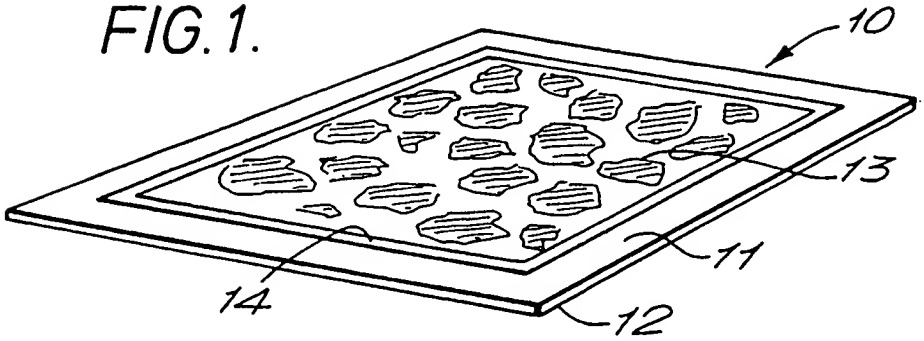
13. A method according to claim 12 in which the design is a reproduction of the grained effect of the simulated natural material and the layer of material reproduces the background colour.

14. A method for producing a glass panel with a decorative finish which consists of a design of relatively fine detail and an overall background colour, including the steps of forming a transfer printed with the design of fine detail in vitreous enamels or ceramics, applying the design to one side of a glass panel, subjecting the glass panel with the applied design to a glass-toughening heat treatment cycle, and including the step of applying a layer of material of the background colour on the same side of the glass panel as the transfer so that the decorative effect is produced by the design and the coloured layer.

15. A method according to any of the preceding claims in which the transfer is a water-slide transfer.

16. A glass panel produced by the method of any of the preceding claims.

FIG. 1.



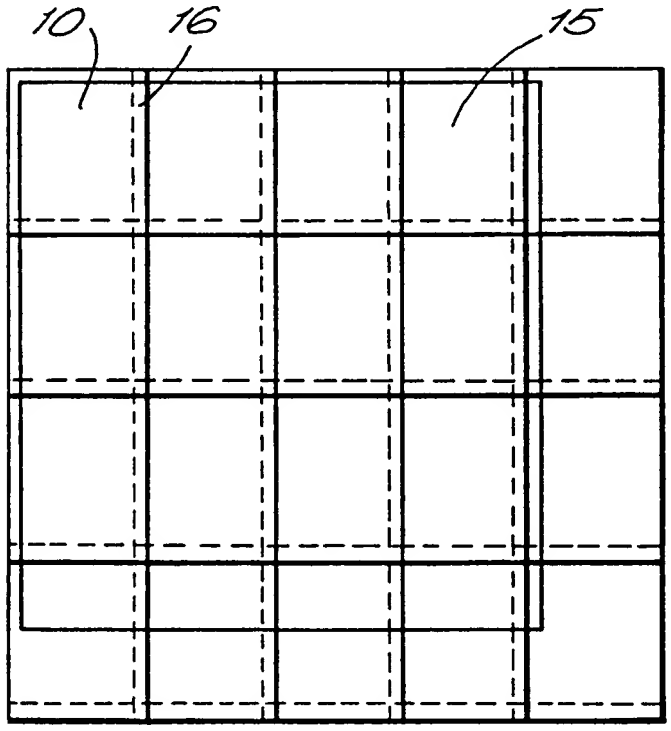


FIG. 2.

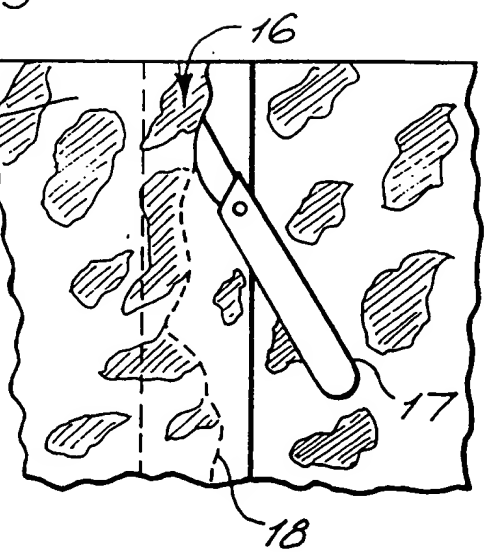


FIG.3.

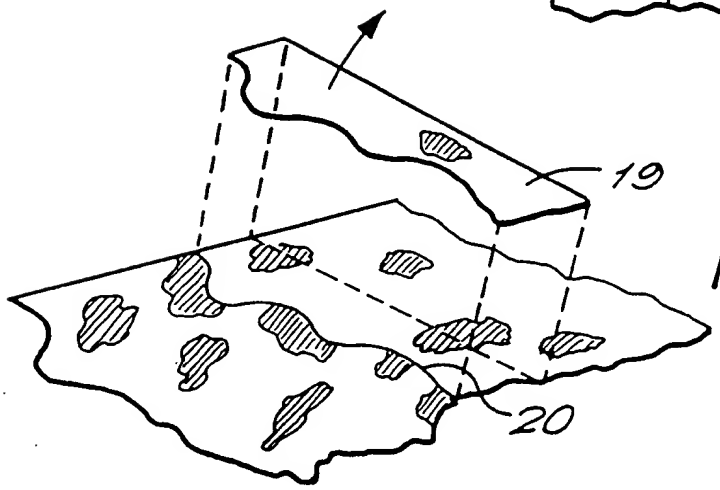


FIG.4.

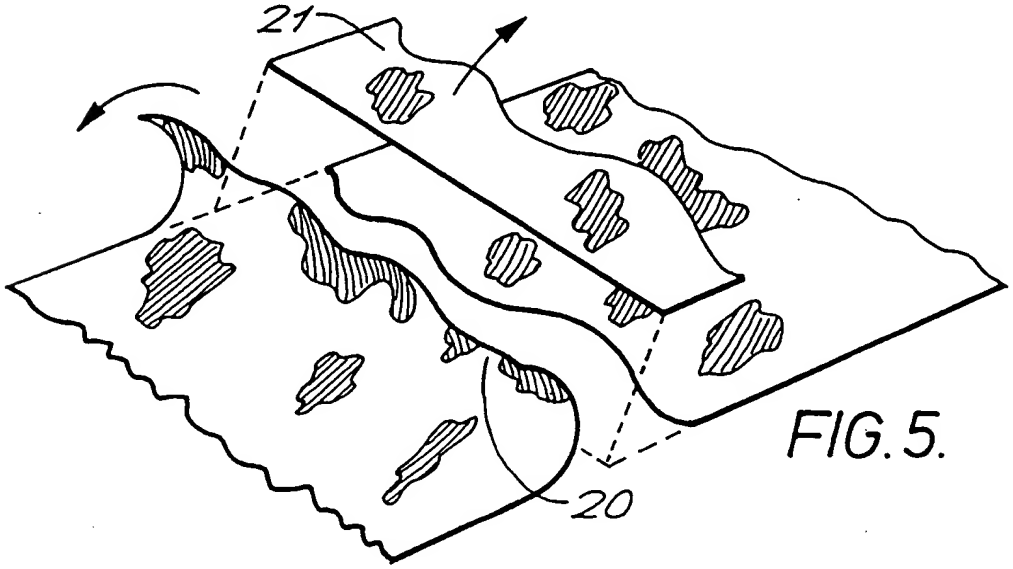


FIG.5.

FIG. 6.

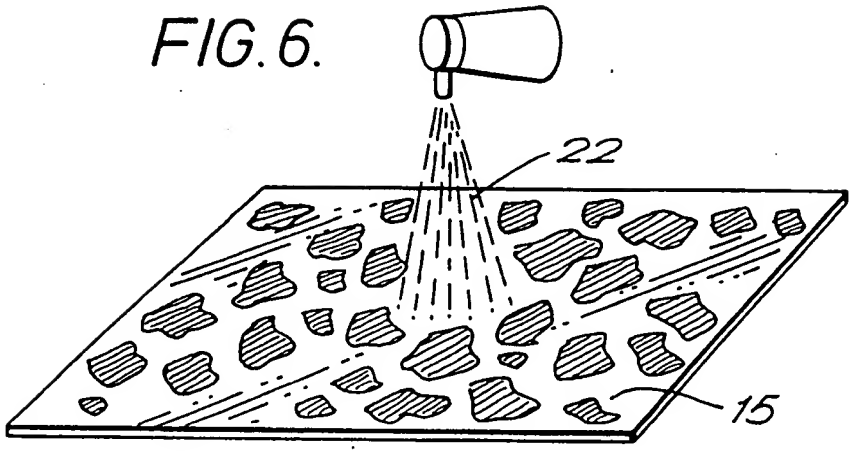


FIG. 7.

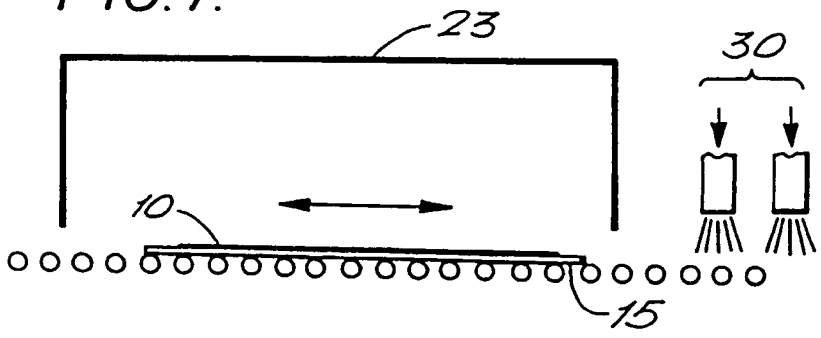
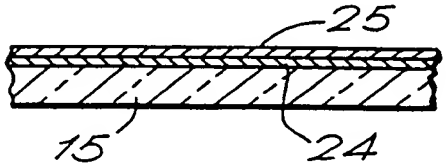


FIG. 8.



INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/GB 94/02616

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B44C1/175 B44C1/17 C03C17/34 C03C17/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B44F B44C C03B C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X, L	DATABASE WPI Week 9445, Derwent Publications Ltd., London, GB; AN 94-365335 & TW,A,228 507 (STAINED GLASS SYSTEMS LTD) 21 August 1994 see abstract The filing date of this document is earlier than the priority claimed (which is the same priority as that of PCT/GB 9402616). ---	1-16
X	US,A,3 956 558 (COMMERCIAL DECAL INC.) 11 May 1976 see column 4, line 10 - column 10, line 22 ---	1,2,4-6, 15,16
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 February 1995	13.03.95

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Doolan, G

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/GB 94/02616

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB,A,2 245 221 (COMMERCIAL DECAL INC.) 2 January 1992 see page 3, line 17 - page 15, line 38	1,2,4-6, 15,16
X	EP,A,0 208 064 (DEGUSSA AKTIENGESELLSCHAFT) 14 January 1987 see the whole document	1,4,6,8, 9,15,16
A	EP,A,0 565 881 (CORNING INCORPORATED) 20 October 1993 see page 2, line 1 - page 2, line 32 see page 4, line 14 - page 4, line 38; examples 1,3	1,2,4-6, 8,9,12
A	GB,A,2 232 414 (STAINED GLASS SYSTEMS LIMITED) 12 December 1990 see page 1, paragraph 3 - page 6, paragraph 1	1,14-16

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

Ir. tional Application No
PCT/GB 94/02616

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-3956558	11-05-76	DE-A-	2353903	16-05-74
		FR-A-	2205490	31-05-74
		GB-A-	1426219	25-02-76
		JP-C-	1107808	13-08-82
		JP-A-	49077910	26-07-74
		JP-B-	56051118	03-12-81
		NL-A-	7315082	07-05-74
GB-A-2245221	02-01-92	US-A-	5132165	21-07-92
EP-A-0208064	14-01-87	DE-C-	3524912	13-11-86
		JP-A-	62017092	26-01-87
EP-A-0565881	20-10-93	US-A-	5256179	26-10-93
		AU-B-	3681093	21-10-93
		JP-A-	6048772	22-02-94
GB-A-2232414	12-12-90	NONE		